

# The Canadian CCS Experience

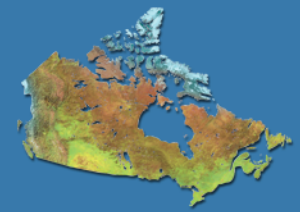
Dubravka Bulut

Office of Energy Research and Development  
Natural Resources Canada

Pittsburgh, Pennsylvania  
*December 12-13, 2007*

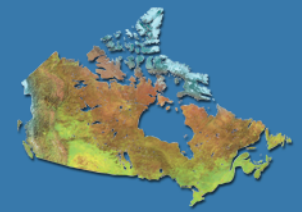


# Outline of Today's Presentation



- **Why is CCS important?**
- **CCS in Canada – What is underway?**
- **Key Messages**

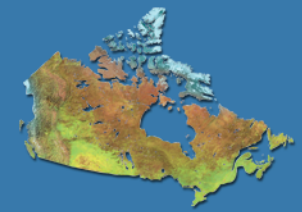




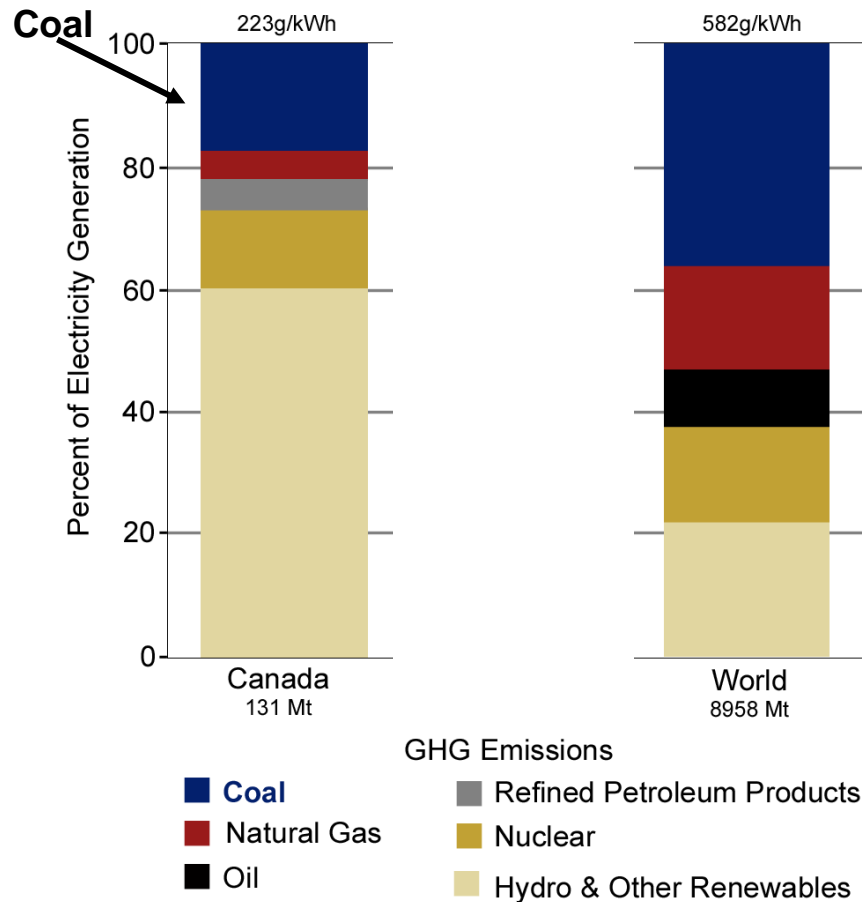
# Why is CCS important?



# Comparing Fuel Mixes – Canada, World



## Fuel Mix for Electricity Generation

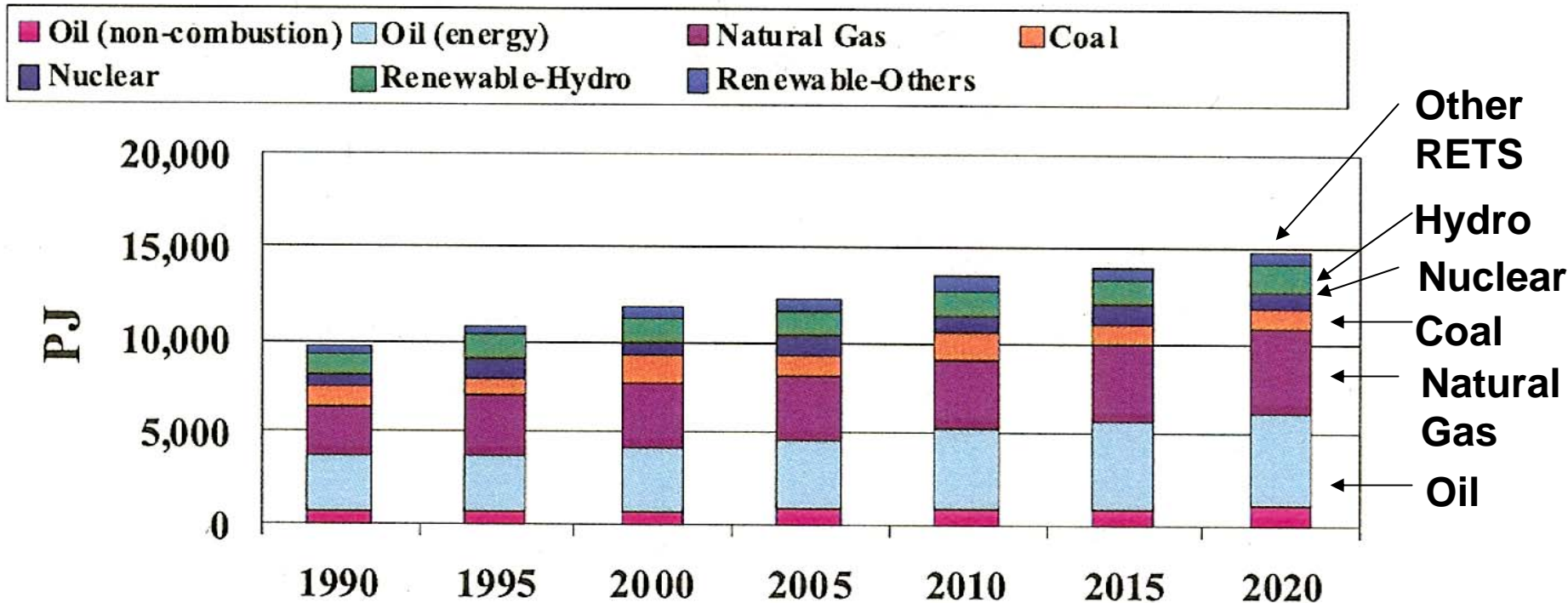


(Source: Pearson, 2003)

- Canada's GHG emission intensity for electricity generation is very low relative to the rest of the world, primarily because of abundant hydroelectricity
- Forecasts show a significant increase in the use of fossil fuels for new generation in Canada



# Primary Energy Demand in Canada



- 20% increase in demand from 2005 to 2020

- Steady growth - oil for transportation, natural gas, renewables

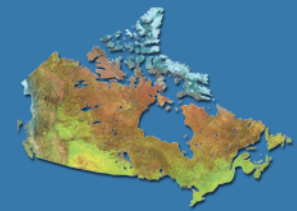
NRCan: Canada's Energy Outlook *The Reference Case 2006*



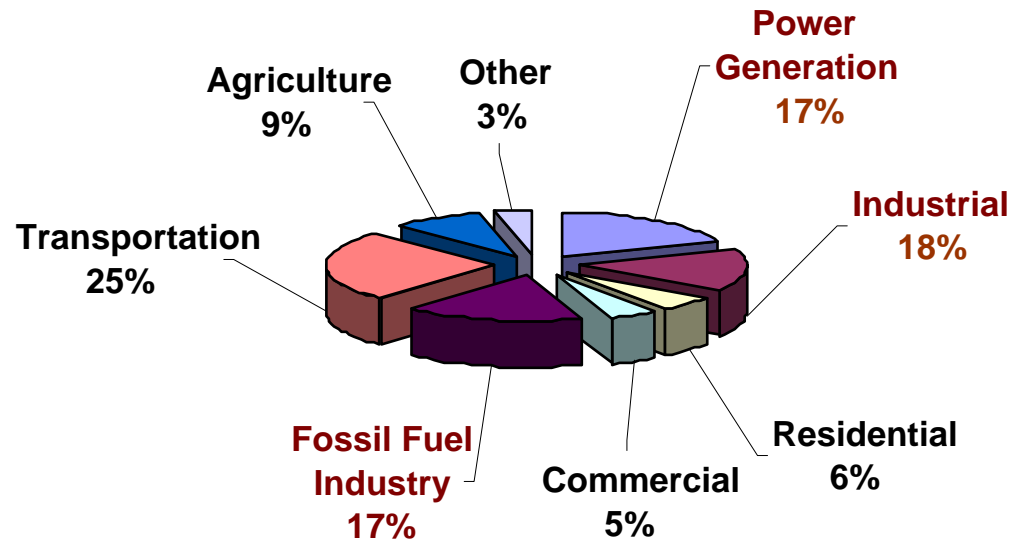
Natural Resources  
Canada

Ressources naturelles  
Canada

# Three Sectors Account for 50%+ of Canada's Share of GHGs



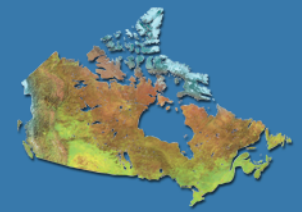
2004 GHG Emissions by Sector (758 Mt)



- Power generation (17%), industrial end-use (18%), fossil fuel supply (17%) dominate Canada's GHG inventory
- Largely point sources
- Major challenge, and an opportunity for CCS

NRCan: Canada's Energy Outlook *The Reference Case 2006*





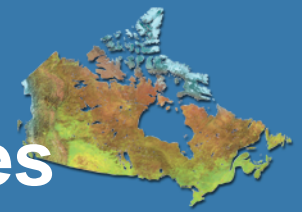
# CCS in Canada

## What is underway?



# Canada's CCS Program

## A Suite of Interdependent Initiatives



***“CCS Program Vision” – Creating the Environment for Implementation of CO<sub>2</sub> Capture, Use and Storage in Canada***

**Science and Technology**

**Developing Frameworks,  
Regulations, Practices**

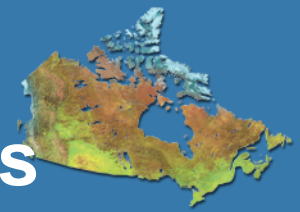
**Strategic Planning, Networks,  
International Initiatives**





# Canada's CCS Program

## A Suite of Interdependent Initiatives



***“Building Blocks” – Creating the Environment for Implementation of CO<sub>2</sub> Capture, Use and Storage in Canada***

### **Science and Technology**

**IEA Weyburn  
Storage,  
Monitoring**

**Assessment  
of Storage  
Potential**

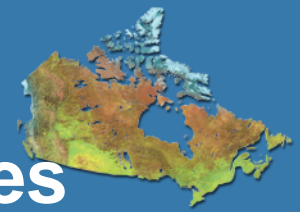
**Enhanced  
Recovery  
Oil, Gas**

**CO<sub>2</sub>  
Capture  
Technologies**



# Canada's CCS Program

## A Suite of Interdependent Initiatives



***“Building Blocks” – Creating the Environment for Implementation of CO<sub>2</sub> Capture, Use and Storage in Canada***

### **Science and Technology**

IEA Weyburn  
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Oil, Gas

CO<sub>2</sub>  
Capture  
Technologies

### **Developing Frameworks, Regulations, Practices**

Storage  
Regulations

Measure,  
Monitoring,  
Verification

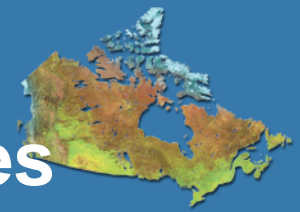
Risk  
Assessment

Public  
Attitudes,  
Acceptance



# Canada's CCS Program

## A Suite of Interdependent Initiatives



### ***“Building Blocks” – Creating the Environment for Implementation of CO<sub>2</sub> Capture, Use and Storage in Canada***

#### **Science and Technology**

IEA Weyburn  
Storage,  
Monitoring

Assessment  
of Storage  
Potential

Enhanced  
Recovery  
Oil, Gas

CO<sub>2</sub>  
Capture  
Technologies

#### **Developing Frameworks, Regulations, Practices**

Storage  
Regulations

Measure,  
Monitoring,  
Verification

Risk  
Assessment

Public  
Attitudes,  
Acceptance

#### **Strategic Planning, Networks, International Initiatives**

Working  
Together

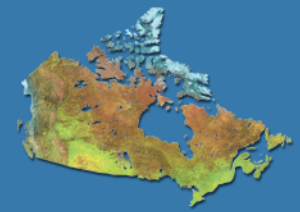
Capacity  
Building,  
Transport'n

Technology  
Roadmap

International  
Collaboration  
Partnerships



# Canada's Technology Roadmaps



## The Clean Coal Technology Roadmap for Canada

[www.cleancoaltrm.gc.ca](http://www.cleancoaltrm.gc.ca)

## The Oil Sands Technology Roadmap for Canada

[http://www.acr-alberta.com/Projects/Oil\\_Sands\\_Technology\\_Roadmap/Oil\\_Sands\\_Technology\\_Roadmap.htm](http://www.acr-alberta.com/Projects/Oil_Sands_Technology_Roadmap/Oil_Sands_Technology_Roadmap.htm)

## CO<sub>2</sub> Capture & Storage Technology Roadmap for Canada

[www.co2trm.gc.ca](http://www.co2trm.gc.ca)

## The Hydrogen Technology Roadmap for Canada

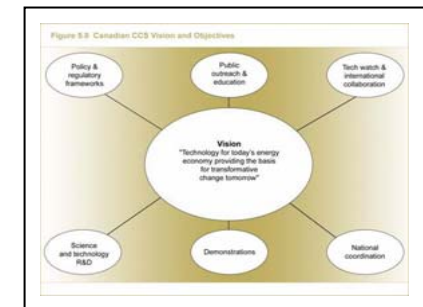
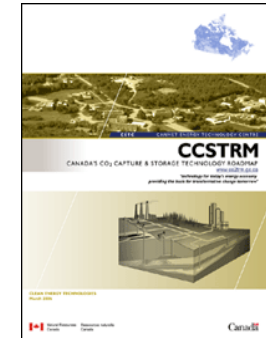
<http://strategis.ic.gc.ca/epic/site/hfc-hpc.nsf/en/mc00008e.html>



# Canada's CCS Technology Roadmap



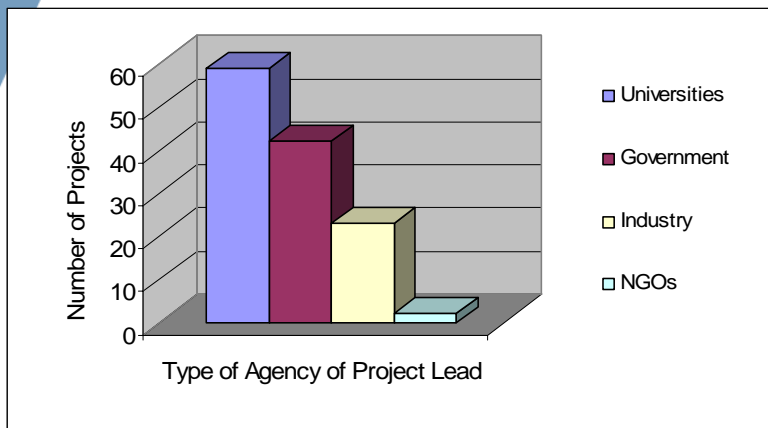
- **Product of the 180+ experts – Canada, US, international**
- **Looks into all aspects of CCS technology ...**
  - Role of CCS in Canada, globally
  - Opportunities for use of CCS technology
  - Current state of CCS technology
  - Specific technology needs and pathways
  - Critical next steps
- **TRM proposes an integrated approach incorporating six key elements:**
  - Policy and Regulatory Frameworks
  - Public Outreach and Education
  - Technology Watch and International Collaboration
  - Science and Technology R&D
  - Demonstration
  - National Coordination



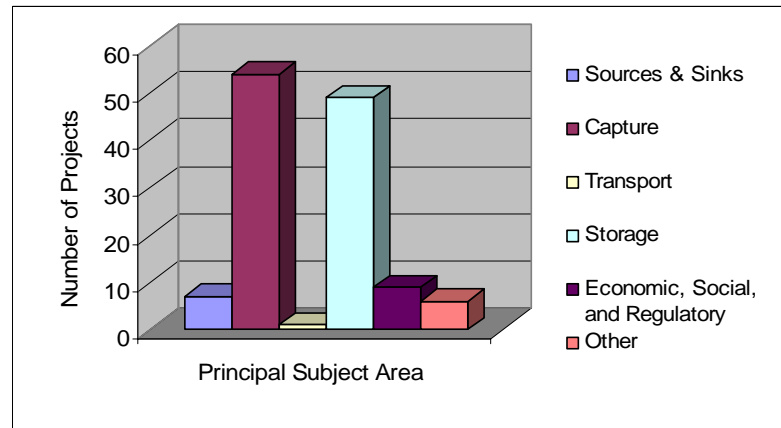
# Overview of CCS Activities in Canada



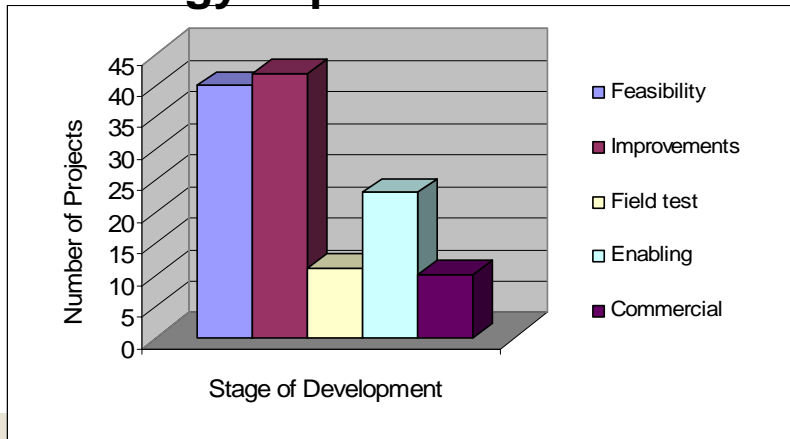
## Organizations Involved - 83



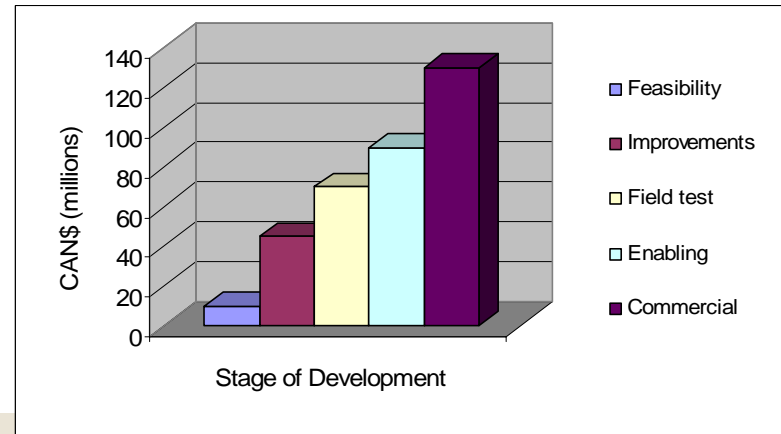
## Focus for RD&D – Capture, Storage



## Types of Work Underway – Feasibility, Technology Improvement

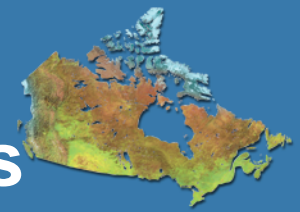


## Funding Across Activities- Commercial, Enabling, Field Testing



# CCS in Canada

## Some Compendium Highlights

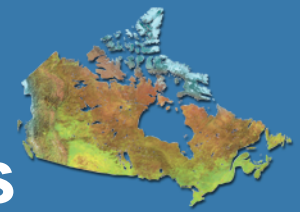


- **Canada is putting a major effort into CCS**
  - 126 projects
  - 83 organizations
  - About \$CDN 340 million in cumulative investments (2003-2005)
- **Players are broad - universities, governments, industry**
- **Funding initially by governments, now dominated by industry**
  - in a few large projects
- **Most projects are at feasibility stage, or technology improvement stage, reflecting the maturity of CCS**



# CCS in Canada

## Some Compendium Highlights



- **At first, focus on technology**
- **Now scope of activities is broadening by adding regulatory, public outreach and business issues**
- **13 CCS projects - underway, planning stages**
  - 7 EOR – 2 commercial, 4 demonstrations, 1 pending
  - 1 enhanced coalbed methane
  - 4 clean coal with CCS – feasibility, planning
  - 1 CO<sub>2</sub> pipeline infrastructure – planning stage





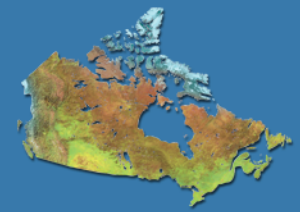
# CCS Among NRCan's Top Energy S&T Priorities



- **CCS is high on our list of technology priorities**
- **ecoENERGY Technology Initiative announced in January**
- **Targeted investment of \$230m in research, development and demonstration of clean energy technologies**
- **Key priorities identified**
  - **CO<sub>2</sub> Capture and Storage** - **Renewable energy, other clean energy sources**
  - **Clean Coal**
  - **Bioenergy** - **Advanced vehicles**
  - **Clean Oil Sands Prod'n** - **Next generation nuclear**
  - **Higher Energy Efficiency – industrial sector and built environment**
- **Action through projects based on public-private partnerships**



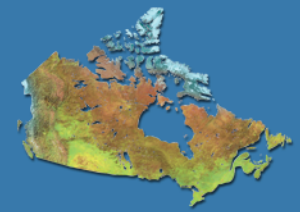
# Natural Resources Canada CCS Program



- **CO<sub>2</sub> Capture related R&D efforts:**
- **NRCan's program is part of many R&D related initiatives presently underway to develop a “near-zero emissions fossil energy” option for Canadians.**
  - **Gasification – towards near-zero emission gasification for coal, petroleum coke, bitumen and biomass into clean by-products**
  - **Oxy-Fuel Combustion – towards a near-zero emission process applicable to all forms of fossil fuels (solid, liquid and gaseous) and multi-product streams**
  - **CO<sub>2</sub> Scrubbing with Solvents - post-combustion process as a stand alone add-on to existing air combustion process, or it can be integrated with either the gasification or oxy-fuel combustion process as a means of improving process efficiencies.**



# Natural Resources Canada CCS Program



- **CO<sub>2</sub> Storage related R&D efforts:**
  - **Weyburn-Midale CO<sub>2</sub> Monitoring and Storage Project - Develop Measurement, Monitoring and Verification of CO<sub>2</sub> storage tool and protocols in an international partnership.**
  - **Assessing storage integrity**
  - **Characterization of and capacity estimates for saline aquifers**
- **Total Funding approx \$10 million/year**
  - **CO<sub>2</sub> Capture R&D -\$4.9 million/year**
  - **CO<sub>2</sub> Storage R&D -\$4.7 million/year**
  - **CO<sub>2</sub> Capture and Storage Roadmaps/Networks**



# Canada is Also Working Internationally Collaborative Initiatives



**Carbon Sequestration Leadership Forum (CSLF)** – To promote the appropriate technical, political, and regulatory environments for the development of CCS technologies in the world

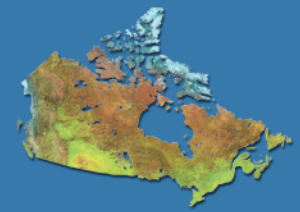
**International Energy Agency (IEA)** – Number of groups addressing mutual CCS issues through collaborative S&T and policy/regulation activities

- Committee on Energy Research and Technologies
- Fossil Fuel Working Party
- Implementing Agreements (e.g. GHG R&D Program)

**US Regional Carbon Sequestration Partnerships Program** - a government/industry effort tasked with determining the most suitable technologies, regulations, and infrastructure needs for CCS

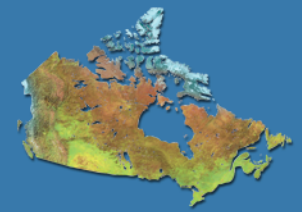


# Collaboration Initiatives (con't)



- **IPCC Special Report on CCS** - regards CCS as a necessary and effective world strategic means of mitigating GHG emissions in the century
- **London Convention** –Storage of carbon dioxide under the seabed will be allowed from 10 February 2007, under amendments to an international convention governing the dumping of wastes at sea.
- **APEC** – Building capacity for CO<sub>2</sub> capture and storage in the APEC region - A Training Manual for Policy Makers and Practitioners

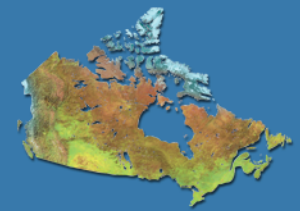




# Key Messages



# Key Messages



- **National and international experts have identified CCS as a key solution to reduce GHG emissions**
- **In addition to power generation, broad range of point source applications**
  - **oil sands, hydrogen production, polygeneration**
- **S&T and policy gaps and needs have been identified – CCS TRM**
- **Federal government, provinces, private sector**
  - **recognize requirements for a strong collaboration**
  - **need for further national and international coordination**
- **CCS will support a regulatory approach to GHG reductions**
- **ecoENERGY Technology Initiative will add to ongoing work to facilitate the development and deployment of CCS technology**

